Check for updates

Stopping crime? The effect of crime re-enactments on eyewitness memory

Hayley J. Cullen ⓘD, Helen M. Paterson ⓘD and Celine van Golde ⓘD

School of Psychology, University of Sydney, Sydney, NSW, Australia

Crime re-enactments broadcast on television encourage witnesses to provide information regarding unsolved crimes. However, given that eyewitness memory can be altered through exposure to post-event information, it is possible that crime re-enactments may influence the memory of eyewitnesses. The current studies examined the effects of crime re-enactments on eyewitness memory. In two experiments (Experiment 1 with a distractor task, Experiment 2 without a distractor task), participants were shown one of three versions of a crime video that differed in their ambiguity. One week later half of the participants viewed a crime re-enactment. All participants then completed a guided free- and cued-recall task regarding the original event. Across both studies, exposure to the re-enactment did not improve eyewitness memory; instead, participants who viewed the re-enactment were more likely to accept the misinformation in the re-enactment. The findings shed light on potential issues with using crime re-enactments to elicit eyewitness accounts.

Keywords: context reinstatement; crime re-enactment; crime stoppers; eyewitness memory; memory; misinformation effect; post-event information.

In 1976, a service station clerk in Albuquerque was shot dead by two armed men, who quickly fled the scene of the crime. While authorities were attempting to solve the crime and locate the perpetrators, limited information was forthcoming from witnesses to the event. Consequently, a re-enactment of the crime was issued by authorities and was broadcast on television, urging witnesses to come forward with anonymous tips. Soon after the re-enactment had aired, a witness came forward with details regarding the vehicle driven by the perpetrators. The witness reported that they had heard a noise, which they believed was a car backfiring at the time, but after viewing the re-enactment they believed the noise was actually a gunshot. Based on the information of this anonymous caller, the perpetrators of the crime were eventually located, charged and convicted of their crime (Crime Stoppers Queensland, 2014).

The above case marked the beginning of Crime Stoppers programmes, now implemented worldwide as a means for witnesses to provide information about crimes anonymously in order to assist law enforcement in investigating crimes (Crime Stoppers Australia, 2018; Crime Stoppers Queensland, 2014; Pfuhl, 1992; Rosenbaum, Lurigio, & Lavrakas, 1989). Such initiatives are typically considered to be helpful investigative tools; half of all calls made through Crime Stoppers programmes were considered 'useful' by authorities (Australian Institute of Criminology, AIC, 2003). Furthermore, approximately one in seven crime

investigators in the UK believed that information provided through Crime Stoppers programmes was vital in solving crimes (Gresham, Stockdale, & Bartholomew, 2003). Therefore, Crime Stoppers programmes are generally considered to have an impact upon the criminal investigative process through statements provided by eyewitnesses.

Crime re-enactment videos are a common feature of televised Crime Stoppers programmes. In a typical crime re-enactment, witnesses are visually taken back to the scene of the crime, often with actors being used to play the parts of the people involved in the offence (AIC, 2003). Such re-enactments are frequently used by Crime Stoppers to convey information about unsolved crimes to the public and appeal for their help (Lurigio & Rosenbaum, 1991; Rosenbaum et al., 1989). It has been estimated that approximately 12% of calls made through Crime Stoppers programmes are prompted through television coverage about a crime, such as a crime re-enactment (Gresham et al., 2003).

Despite the widespread use and influence of crime re-enactment videos within criminal justice systems around the world, no research yet has investigated the effect of crime re-enactments on eyewitness memory. This is surprising, given that research has consistently demonstrated the fallibility of memory, such that memory can decay rapidly and change over time (Sharps, Herrera, & Price-Sharps, 2014). Additionally, the problems with eyewitness memory have been highlighted by the contribution of eyewitness misidentifications to cases of wrongful conviction, whereby over 70% of wrongful convictions overturned by DNA evidence involved faulty eyewitness identification (Innocence Project, 2015). As Crime Stoppers programmes are reliant on what eyewitnesses remember and report, the testimony of eyewitnesses forms an incredibly important part of the investigative process (Kebbell & Milne, 1998). It is therefore particularly important that callers who have viewed a crime re-enactment are able to provide accurate information regarding perpetrators of crimes (Rosenbaum et al., 1989).

Investigating crime re-enactments is important because crime re-enactments may impact upon eyewitness memory by acting as a source of post-event information (PEI): information about a crime that witnesses are exposed to after it has occurred. It is not uncommon for witnesses to be exposed to PEI after they have witnessed an event, and before they provide their recall for that event (Frenda, Nichols, & Loftus, 2011; Wright & Stroud, 1998). Concerningly, most research has demonstrated negative consequences of encountering PEI, finding that inaccurate PEI (misinformation) can become incorporated into the eyewitness's memory for the original event, thereby rendering their memories for such details inaccurate (Greene, Flynn, & Loftus, 1982; Loftus, 2005; Morgan, Southwick, Steffian, Hazlett, & Loftus, 2013). On the contrary, studies have also revealed that participants exposed to correct PEI about an event were more accurate in recalling those details than participants who were not exposed to the correct PEI (Harkness, Paterson, Denson, Kemp, Mullan, & Sainsbury, 2015; Paterson & Kemp, 2006). However, so far studies investigating the effects of PEI on eyewitness memory have focused mostly on PEI encountered through sources such as leading questions, media reports and co-witness discussion (Wright, Self, & Justice, 2000). No research to date has investigated the effects of crime re-enactments on eyewitness memory.

Crime re-enactments have many unique features that distinguish them from other sources of PEI, and therefore may have a unique effect on eyewitness memory. Firstly, crime re-enactments differ from other sources of PEI because they often revisit the actual scene of the crime, where the environment replicates that of the original event (AIC, 2003). As such, the re-enactment acts as a form of physical context reinstatement by re-exposing witnesses or victims to the setting where the event of interest took place (Hershkowitz,

Orbach, Lamb, Sternberg, & Horowitz, 2002). Such context reinstatement can facilitate memory retrieval (Krafka & Penrod, 1985). For example, one study found that participants who returned to the same classroom as the one where they were exposed to a target person were more accurate in identifying the target person than were participants who were taken to a different classroom from the original context (Smith & Vela, 1992). Additionally, a re-enactment may assist eyewitnesses in remembering certain details about a crime, because they are exposed to correct PEI for aspects of the context that are true to the original crime scene. Consequently, crime re-enactments may enhance memory for correct PEI similarly to previous research involving co-witness discussions (e.g. Paterson & Kemp, 2006; Vredeveldt, Hildebrandt, & van Koppen, 2016), but may also go above and beyond this due to physical context reinstatement effects.

Whilst crime re-enactments may improve memory as discussed above, it is also possible that they may simultaneously have a negative effect on eyewitness accounts. Crime re-enactments may contain misinformation regarding the criminal event, as a result of their unique features. Firstly, the purpose of a re-enactment is to allow witnesses to provide additional information regarding a crime (AIC, 2003). Therefore, many details regarding the crime remain unknown, and as such the re-enactment may portray some details of the event inaccurately. Secondly, actors in crime re-enactments cannot perfectly replicate the people whom they represent, so these actors (and their different features) may act as an additional source of misinformation. Finally, crime re-enactments may be sensationalized and dramatized for entertainment (AIC, 2003; Lurigio & Rosenbaum, 1991), and thus may not be a true reflection of the crime. It is therefore possible that through these unique features of crime re-enactments, misinformation provided through the re-enactment may become incorporated into the

witness's memory for the event (see Loftus, 2005, for a review on the misinformation effect). According to the Source Monitoring Framework (Johnson, Hashtroudi, & Lindsay, 1993) acceptance of misinformation results from a witness's inability to correctly identify the source of the misinformation. In other words, the witness may misattribute new or inaccurate details from the re-enactment as details that they had observed in the original event instead. As such, crime re-enactments may distort a witness's memory for key details about the crime.

Whilst there are several possible ways in which crime re-enactments may provide misinformation, it is important to note that re-enactments frequently contain warnings stating that they are re-enactments using actors. However, research exploring the effects of warnings regarding misinformation has produced mixed results regarding the effectiveness of warnings (Echterhoff, Hirst, & Hussy, 2005; Greene et al., 1982; Monds, Paterson, & Whittle, 2013; Paterson, Kemp, & Ng, 2011). Exposure to even subtle forms of misinformation within a crime re-enactment may have a negative effect on eyewitness memory regardless of warnings being provided; this may be counterproductive to the purposes of the re-enactment in assisting eyewitnesses in remembering events.

One further factor to consider when judging the efficacy of crime re-enactments is that re-enactments are designed to specifically target witnesses who have not yet come forward with information about a crime. While there are many reasons why a witness might not provide information related to a criminal offence, one reason may be that they were not aware that a criminal offence had occurred when witnessing it. For example, crimes such as pickpocketing or kidnapping may be ambiguous and may not appear as crimes when the individual originally witnessed the event (James, 1986). The Albuquerque murder case described in the opening paragraph of this paper describes

such a situation, where only after viewing the re-enactment did the witness realize that what they had heard and witnessed was, in fact, part of a serious crime, rather than a benign event (Crime Stoppers Queensland, 2014). In other instances, crimes may not be interpreted as such because the witness was distracted or preoccupied when the crime occurred (Lane, 2006). Therefore, crimes that are ambiguous at the time that they occur may influence when and what an eyewitness reports about those events.

Crime ambiguity is yet to be investigated in the context of eyewitness memory; however, a related study has investigated the effects of crime *seriousness* on eyewitness memory (Leippe, Wells, & Ostrom, 1978). This study found that witnesses were more likely to accurately identify the perpetrator of a crime when the crime was more serious (as indicated by the value of the item the perpetrator stole), but only if the witness was aware of the seriousness of the crime as it happened (i.e. only when participants knew the value of the item before it was stolen). This was likely due to the witnesses paying greater attention to the crime when informed about the seriousness, which may have led to better encoding of the event (Leippe et al., 1978; Nelson, Laney, Bowman Fowler, Knowles, Davis, & Loftus, 2011). This finding suggests that a witness who interprets a witnessed event as a crime may show increased memory accuracy compared to a witness who does not interpret the event as a crime. However, interpreting an event as a crime may increase the witness's stress/anxiety response, which may in turn have a negative impact on their memory (for a review on stress and memory, see Deffenbacher, Bornstein, Penrod, & McGorty, 2004). As such, it is important to precisely determine how the ambiguity of a crime impacts upon awareness of a crime, and how the ambiguity of the crime subsequently impacts upon eyewitness memory.

Not only might the ambiguity of a crime determine the accuracy with which an eyewitness will report the event, but it may also impact the influence of crime re-enactments on witness memory. As illustrated in the murder case above, sometimes an eyewitness may not be aware that a crime occurred until they are exposed to PEI, such as a crime re-enactment on television. Witnesses who were not aware that the witnessed event was, in fact, a crime may rely more heavily on the information in the re-enactment than those who were aware that a crime had taken place. Previous research has demonstrated that lower memory strength (through poorer encoding of the event) may make witnesses more susceptible to PEI within the re-enactment, particularly when that PEI is inaccurate (Lindsay, 1993; Pezdek & Roe, 1995). Therefore, lack of awareness that a crime has occurred may result in greater acceptance of the misinformation within the re-enactment.

The present experiments

The current experiments were primarily interested in exploring how crime re-enactments may influence eyewitness memory, and whether this aligns with how influential witnesses believe these re-enactments actually are on their memory. Our secondary aim was to investigate whether or not eyewitness memory would differ based on the ambiguity of the criminal event witnessed, and whether this would influence the impact of the re-enactment on eyewitness memory. In two experiments, participants were shown a video containing an ambiguous kidnapping, an unambiguous kidnapping or no kidnapping. These different videos were created to manipulate the degree of ambiguity of the crime and to compare ambiguous and unambiguous crimes to a no-crime control. In Experiment 1, participants completed a divided attention task while they viewed the video, which served to disguise the purpose of the experiment and further enhance the ambiguity of the ambiguous crime. In Experiment 2, participants did not complete a divided attention task. One

week later, half of the participants were shown a crime re-enactment video, while the other half were not. The re-enactment contained both correct and incorrect PEI (misinformation), with a warning message that the video was a re-enactment and featured the use of actors. Finally, all participants completed guided free-recall and cued questions about the events that took place in the initial eyewitness event one week prior. Participants who viewed the re-enactment were also asked to rate how influential they believed the re-enactment was on their memory report.

Consistent with research into physical context reinstatement (Hershkowitz et al., 2002) and correct PEI (Harkness et al., 2015; Paterson & Kemp, 2006), respectively, it was expected that participants who were shown the crime re-enactment would show increased memory accuracy overall and also accept significantly more correct PEI than those who were not shown the re-enactment. However, in line with past research on the misinformation effect when warnings are provided (e.g. Monds et al., 2013; Paterson et al., 2011), it was also expected that participants who viewed the re-enactment would report significantly more of the misinformation that was provided within the re-enactment, regardless of the warning messages within the re-enactment. In relation to crime ambiguity, as the ambiguous crime was expected to be interpreted as a neutral event, it was expected that those who viewed the ambiguous crime and those who did not view a crime (i.e. control) would show significantly lower levels of awareness of a crime than those who viewed the unambiguous crime. Given that research has found that the perceived seriousness of a crime during encoding influences memory accuracy (Leippe et al., 1978), it was expected that participants who viewed the unambiguous crime would be more accurate and more detailed in their memory, and would accept significantly less misinformation if shown the re-enactment than those in the ambiguous and no crime conditions.

Experiment 1
Method
Participants

One hundred and thirty-eight first-year psychology students participated in the current study in exchange for course credit. The data of three participants were excluded for failing to complete all aspects of the study, and the data from one additional participant were excluded for failing to make a serious attempt during the second session, leaving a valid sample of 134 (86 females) with a mean age of 20.16 years ($SD = 4.73$, range $= 17$–52 years).

Design

The study consisted of a 3×2 design, investigating the effects of ambiguity of crime (no crime vs. ambiguous crime vs. unambiguous crime) and exposure to crime re-enactment (not present vs. present) on memory recall accuracy and susceptibility to PEI. Participants were randomly allocated across conditions. When the re-enactment was not present, there were 21, 23 and 22 participants in the no crime, ambiguous crime and unambiguous crime conditions, respectively. When the re-enactment was present, there were 22, 23 and 23 participants in the no crime, ambiguous crime and unambiguous crime conditions, respectively.

Apparatus and materials

Anxiety questionnaire. Participants completed the State–Trait Anxiety Inventory (STAI; Spielberger, 1983). They completed the state version of the questionnaire both immediately before and immediately after viewing the eyewitness stimulus, to determine whether the differing ambiguity of the eyewitness events had an effect on the state anxiety in participants.

Eyewitness stimulus. The eyewitness stimulus consisted of a video of a kidnapping scene at a bus stop. The video was broken up into segments, with each segment separated by a 10-s break. Participants completed a distractor task

while viewing the video. Specifically, participants were asked to note down the number of buses, and how many seconds had passed in the segment they had just seen. The purpose of this distractor task was to conform to the cover story of 'Personality and Time Perception', a cover story similar to that used by a previous study which looked at incidental versus intentional encoding (Migueles & García-Bajos, 1999). Therefore our distractor task allowed us to look at incidental awareness of the crime, as opposed to intentional. The distractor task also ensured that participants' attention was kept on the video, as it gave them a specific task to complete and report on.

In the video, every participant witnessed a young girl being dropped off at the bus stop and later being approached by an older woman who conversed with the girl. In the no kidnapping condition, the video did not show the child or the woman leaving the bus stop; instead the video ended before any kidnapping occurred. In the ambiguous kidnapping condition, the video showed an additional scene where the woman offered the girl a chocolate bar from her handbag, took the girl's hand, and led her away calmly from the bus stop. This kidnapping was ambiguous in nature, as there was no struggle or signs of immediate distress from the child. In contrast, the unambiguous kidnapping showed the woman forcefully dragging the girl away from the bus stop, while the girl could be heard calling for help. The videos (without breaks) last for 2 min 06 s, 2 min 25 s, and 2 min 22 s, respectively.

Post-event information. A re-enactment video was filmed from the perspective of the missing child's mother. The mother begins by explaining how her child came to be at the bus stop, and is accompanied by footage of a child (played by an actor) getting out of a car and walking towards the bus stop. As the child gets out of the car, the perpetrator (also played by an actor) can be seen sitting at the bus stop bench with her attention focused on the girl. The re-enactment is accompanied by a

warning message across the bottom of the video about the use of actors. Correct PEI contained within the re-enactment included details such as the child carrying a ball, the child with a backpack, and the perpetrator wearing black. Misinformation items from the re-enactment included details such as the colour of the car (now blue rather than red), the young girl wearing a headband (when originally she had not) and the perpetrator wearing a scarf (when originally she had not). Only participants assigned to the re-enactment condition were exposed to correct and incorrect PEI. Given that the re-enactment was re-filmed at the scene of the original event, the researchers were unable to control for the amount of correct and incorrect PEI that was present within the re-enactment, nor make these two forms of PEI equivalent (in regard to amount and centrality). In total, there were 21 items of misinformation and 68 items of correct information. A full list of correct and incorrect PEI items within the re-enactment is provided in the Appendix.

Recall. Participants completed a guided free recall account of the original video followed by cued recall questions. The guided free recall task originated from a previous study on the effect of correct PEI and misinformation on witness memory (Paterson & Kemp, 2006) and consisted of open-ended questions relating to the sequence of events, the setting and the people involved. The cued recall featured more specific questions about the video, such as what the child looked like, what the child did at the bus stop, and whether there were any suspicious persons present at the bus stop. Participants were encouraged to be as accurate and as descriptive as possible, and were given as much time as needed to complete their responses.

Recall coding. Recall responses were coded based on whether the information was: (a) correct, (b) incorrect, (c) correct PEI, or (d) incorrect PEI (misinformation). Coders were

instructed not to code responses that were purely related to the distractor task (e.g. perception of time), that were subjective or that were unable to be interpreted. Initially, two coders went through and identified all details present within each of the three crime conditions. The two coders identified 327 details within the no crime video, 345 details within the ambiguous crime video and 343 details within the unambiguous crime video. To assess inter-rater reliability, 14 (10%) of the responses were selected by a random number generator and coded by the two independent coders. Significant correlations were found between the two coders for correct ($r = .955$, $n = 14$, $p < .01$, two-tailed), incorrect ($r = .767$, $n = 14$, $p < .01$, two-tailed), correct PEI ($r = .843$, $n = 14$, $p < .01$) and misinformation ($r = .733$, $n = 14$, $p < .01$) items.

Procedure

Upon signing up for the study, participants were led to believe that the purpose of the study was to investigate personality and time perception. In Session 1, participants completed personality questionnaires and a baseline measure of state anxiety (using the STAI). Participants then viewed the version of the video to which they had been randomly assigned (no crime vs. ambiguous crime vs. unambiguous crime). Participants were instructed to imagine that they were present at the bus stop and waiting for a particular bus to arrive. While viewing the video they completed the distractor task between each segment of the video. After the video, participants completed the STAI, additional filler questionnaires and questions probing for suspicion of the true purpose of the study.

One week later in Session 2, the experimenter reminded participants of the video from the previous week. They were then told that a child had been reported missing and was last seen at the bus stop that they had been asked to imagine they were waiting at the previous week. For ethical reasons, participants were told that this was a fictitious scenario,

and that while a child from the original footage was 'reported missing', the footage was scripted, and no child was actually missing. Participants who had been randomly allocated to the re-enactment condition were then shown the re-enactment video, while the others were not. All participants were informed that they would be asked questions about their memory of the video from the previous week only, and that they should be as accurate and as detailed as possible when answering each question. Following the recall tasks, participants were asked what they believed to be the true purpose of the study, as well as whether they believed they had seen a crime in the original eyewitness video. This awareness question was completed at the end of the study to ensure responses to this question did not cause suspicion among participants, and so their response to the question did not influence their memory recall in Session 2. Finally, participants who were exposed to the re-enactment in Session 2 were asked how influential they believed the re-enactment was on their memory of the event, on a scale of 1–5 (where 1 = 'not at all', and 5 = 'extremely'). All participants provided demographic information and were then fully debriefed about the nature and aims of the study. All aspects of the study were approved by the University's Human Research Ethics Committee.

Results

Statistical analyses focused on the following questions: first, did the ambiguity of the crime affect awareness that a crime took place? Second, how did exposure to crime re-enactment (not present vs. present) and ambiguity of crime (ambiguous kidnapping vs. unambiguous kidnapping vs. no crime) influence participants' memory accuracy and susceptibility to PEI?

Preliminary analyses

Analyses were conducted to ensure that there were no differences between conditions in

Table 1. Self-reported awareness of crime across crime conditions.

Crime conditions	Yes N (%)	No N (%)
No crime	1 (2.3)	42 (97.7)
Ambiguous crime	16 (34.8)	30 (65.2)
Unambiguous crime	21 (46.7)	24 (53.3)
Total awareness	38 (28.4)	96 (71.6)

Note: $N = 134$. Percentages across condition.

terms of age and gender. Chi-square analyses revealed no significant gender differences across crime ambiguity, $\chi^2(2, N = 134) = 0.718$, $p = .698$, or re-enactment conditions, $\chi^2(1, N = 134) = 1.465$, $p = .226$. Likewise, one-way analyses of variance (ANOVAs) revealed no age differences between crime ambiguity, $F(2, 131) = 0.152$, $p = .860$, or re-enactment conditions, $F(1, 132) = 0.013$, $p = .909$.

All participants were asked what they believed to be the purpose of the study at the end of both sessions. No participants correctly identified the purpose of the study at the end of the first session, nor did any participants mention PEI/re-enactment or crime awareness at the end of the second session. Participants were also asked whether they had mentioned the study or the video with anyone else outside of the experiment in the week delay between the two experimental sessions. Six participants answered 'Yes' to discussing the video with another person; however, when these six participants were excluded from analyses it had no effect on the results, so all participants were included in the final analyses.

Crime awareness

Chi-square tests were performed to assess whether there were differences in crime awareness across crime ambiguity conditions (see Table 1). The relation between these variables was significant, $\chi^2(2, N = 134) = 22.703$, $p < .001$, indicating that crime awareness differed based on the type of crime witnessed. Additional chi-square tests were run to test for differences in crime awareness for each pair of groups separately. Crime awareness did not significantly differ between the ambiguous and unambiguous crimes, $\chi^2(1, N = 91) = 1.332$, $p = .249$. However, there was a significant difference in crime awareness between participants who viewed the no crime and those who viewed the ambiguous crime, $\chi^2(1, N = 89) = 15.151$, $p < .001$, as well as between participants who viewed the no crime and those who viewed the unambiguous crime, $\chi^2(1, N = 88) = 23.057$, $p < .001$. This suggests that, overall, participants were equally aware of both the criminal events, but understandably were more likely to report these events as crimes than the no-crime counterpart.

Anxiety

A one-way ANOVA revealed that there was no difference across crime ambiguity conditions in baseline levels of state anxiety prior to viewing the eyewitness stimulus, $F(2, 131) = 1.137$, $p = .324$, $\eta^2_p = .017$. Next, changes in participants' anxiety were measured by subtracting scores on the post-video STAI from scores on the pre-video STAI. A one-way ANOVA showed that there was no effect of crime ambiguity on changes in levels of anxiety, $F(2, 131) = 2.015$, $p = .137$, $\eta^2_p = .030$. Therefore, elevation in anxiety is unlikely to account for any subsequent differences in memory across crime ambiguity conditions.

Guided free recall

Findings from the guided free recall and short answer questions were largely consistent.

For the purposes of brevity, only guided free-recall data from the current study are reported. Any differences are reported in footnotes.

Correct details. There was a significant main effect of crime ambiguity on the number of correct details reported during guided free recall, $F(2, 128) = 4.507$, $p = .013$, $\eta^2_p = .066$. Post hoc contrasts adjusting for the Bonferroni correction showed that participants who saw the ambiguous crime video ($M = 34.87$, $SD = 14.14$) provided significantly more correct details than participants who saw the no crime video ($M = 27.16$, $SD = 10.89$), $F(1, 128) = 8.233$, $p = .005$, $\eta^2_p = .060$. However, there was no difference in the number of correct details reported across participants who saw the unambiguous crime or the ambiguous crime ($M = 33.20$, $SD = 12.13$), $F(1, 128) = 0.397$, $p = .530$, $\eta^2_p = .003$, or across participants who saw the unambiguous crime or the no crime video when correcting the alpha using the Bonferroni procedure (with an adjusted alpha of .0167), $F(1, 128) = 4.990$, $p = .027$, $\eta^2_p = .038$.[1] The main effect of re-enactment, $F(1, 128) = 0.104$, $p = .747$, $\eta^2_p < .001$, and the interaction between re-enactment and ambiguity conditions on number of correct details reported, $F(2, 128) = 0.043$, $p = .958$, $\eta^2_p < .001$, were both not significant.

Incorrect details. Incorrect details consisted of distortion of memory for witnessed details, spontaneous errors and errors made on post-event information items. A two-way ANOVA revealed no significant main effects [*crime ambiguity:* $F(2, 128) = 1.076$, $p = .344$, $\eta^2_p = .017$; *re-enactment:* $F(1, 128) = 2.205$, $p = .140$, $\eta^2_p = .017$] or interactions between re-enactment presence and crime ambiguity on number of incorrect details reported, $F(2, 128) = 0.621$, $p = .539$, $\eta^2_p = .010$.

Correct post-event information. The total number of correct PEI items correctly recalled by participants was compared across re-enactment and crime ambiguity conditions; however, the main effects of crime ambiguity, $F(2, 128) = 2.796$, $p = .065$, $\eta^2_p = .042$,[2] and re-enactment, $F(1, 128) = 0.038$, $p = .846$, $\eta^2_p < .001$, were not significant. Likewise, the interaction between crime ambiguity and re-enactment was also not significant, $F(2, 128) = 0.117$, $p = .890$, $\eta^2_p = .002$.

Misinformation. The total number of misinformation items reported by participants across all crime conditions and re-enactment conditions was analysed using a two-way ANOVA. There was a significant effect of re-enactment on reporting of misinformation, $F(1, 128) = 10.060$, $p = .002$, $\eta^2_p = .073$. Specifically, participants who viewed the re-enactment reported significantly more misinformation items ($M = 0.68$, $SD = 0.89$) than participants who did not view the re-enactment ($M = 0.27$, $SD = 0.54$). The main effect of crime ambiguity was not significant, $F(2, 128) = 1.502$, $p = .226$, $\eta^2_p = .023$,[3] and the interaction between re-enactment and crime ambiguity was also not significant, $F(2, 128) = 0.030$, $p = .971$, $\eta^2_p < .001$.

Within-groups analyses were conducted to explore how viewing the re-enactment affected reporting of misinformation within each crime condition. For the no crime condition, there was a significant effect of re-enactment condition on misinformation items reported, $F(1, 41) = 5.580$, $p = .020$, $\eta^2_p = .125$. Participants who viewed the re-enactment ($M = 0.55$, $SD = 0.80$) reported significantly more misinformation within the no crime condition than participants who did not view the re-enactment ($M = 0.10$, $SD = 0.30$). However, for the ambiguous and unambiguous crime conditions, there was no effect of viewing the re-enactment on reporting of misinformation [*ambiguous:* $F(1, 44) = 2.189$, $p = .146$, $\eta^2_p = .047$; *unambiguous:* $F(1, 43) = 3.507$, $p = .068$, $\eta^2_p = .075$].[4]

Accuracy. Accuracy of the participant's guided free recall statement was measured by

Table 2. The extent to which participants in the re-enactment condition believed the re-enactment affected their memory.

	Participants N (%)
Not at all	7 (10.3)
Slightly	17 (25.0)
Somewhat	24 (35.3)
Very	16 (23.5)
Extremely	4 (5.9)

Note: $N = 68$.

dividing the total correct details reported by the total number of details reported. A two-way ANOVA revealed no main effects of crime ambiguity,[5] $F(2, 128) = 0.2115$, $p = .807$, $\eta^2_p = .003$, or re-enactment, $F(1, 128) = 1.923$, $p = .168$, $\eta^2_p = .015$, on memory accuracy. Likewise, there was no significant interaction between re-enactment presence and crime ambiguity on recall accuracy, $F(2, 128) = 1.131$, $p = .326$, $\eta^2_p = .017$.

Influence of re-enactment

Participants who had been shown the re-enactment were asked how influential they believed the re-enactment was on their recall responses, measured on a 5-point Likert scale (where *1* = 'not at all' and *5* = 'extremely'). Responses to this question are displayed in Table 2. A chi-square revealed that there were no differences in how influential the re-enactment was perceived to have been across ambiguity conditions, $\chi^2(8, N = 68) = 7.293$, $p = .505$.

Discussion

The findings from Experiment 1 suggested that exposure to a re-enactment provided no benefit to participants' memory during guided free recall. In particular, participants who were exposed to the re-enactment during Session 2 were no more accurate overall, and did not report significantly more correct PEI during guided free recall than participants who did not see the re-enactment. In contrast, exposure to the re-enactment appeared to have a negative effect on eyewitness memory. Specifically, participants who viewed the re-enactment that contained misinformation were more likely to report the misinformation than participants who did not view the re-enactment. Therefore, crime re-enactments may not be as useful as initially thought (AIC, 2003), especially when it comes to the major aim of obtaining accurate information through free recall in relation to cases of unsolved crime (Rosenbaum et al., 1989).

Additionally, the ambiguity of the crime that participants saw did not have any effect on the influence of the re-enactment, as it was expected that participants who saw an ambiguous crime or no crime at all would rely more heavily on the re-enactment when completing their recall. In addition, during both free and cued recall, there was no difference in memory across participants who viewed the unambiguous kidnapping and participants who viewed the ambiguous kidnapping. This lack of difference in memory across the unambiguous and ambiguous kidnappings may be a result of the fact that awareness that a crime had taken place in the eyewitness stimulus did not significantly differ across participants who saw either of the two crimes. One explanation for this may be that the distractor task that participants were given to complete while viewing the eyewitness stimulus may have taken participants' attention away from the crime in question, subsequently reducing awareness for the unambiguous crime to lower levels than expected. Research has shown that focused attention may lead to inattentional blindness, a failure to notice unexpected events (such as crimes) when attention is devoted to something else (Chabris, Weinberger, Fontaine, & Simons, 2011; Simons & Chabris, 1999). Consequently, a follow-up study was conducted in order to assess whether crime ambiguity leads to differences in awareness in the absence of a distractor task, and whether this ambiguity will subsequently affect the

influence of a crime re-enactment on witness memory.

Experiment 2

The results of Experiment 1 suggest a detrimental effect of crime re-enactments on eyewitness memory, particularly with regard to details for which misinformation has been provided. However, crime ambiguity had an unexpected effect on memory. This may have been because there were no differences found in crime awareness across participants who saw the ambiguous and the unambiguous kidnapping. As said above, this could be explained with the distractor task that was implemented throughout the video, resulting in inattentional blindness regardless of ambiguity condition. Lastly, natural memory decay or response/hindsight bias might have influenced participants' responses to whether they were aware of a crime taking place, as this question was asked at the end of the second session, one week after participants viewed the eyewitness stimulus. Taken together, these aspects of the methodology may have impacted upon how crime ambiguity affected eyewitness memory and the influence of the re-enactment.

In light of these methodological shortcomings, Experiment 2 sought to answer the same research questions as Experiment 1, but differed from Experiment 1 in the following: (a) the distractor task was removed when viewing the eyewitness stimulus, as the distractor task may have accounted for the low levels of awareness within the unambiguous kidnapping condition in Experiment 1, and (b) an additional awareness question was asked immediately after the eyewitness stimulus in the first session of the experiment, in order to assess immediate awareness of the crime.

Method

Participants

One hundred and seventy-four first-year psychology students volunteered for the experiment in exchange for course credit.

The data were excluded from 11 participants for failing to complete all aspects of the study, and a further one participant due to experimenter error, leaving a valid sample of 162 participants (116 female) with a mean age of 20.54 years ($SD = 4.81$; range $= 18$–42 years).

Design

Like Experiment 1, Experiment 2 consisted of a 2×3 design investigating the effects of exposure to crime re-enactment (not present vs. present) and ambiguity of the crime (no crime vs. ambiguous crime vs. unambiguous crime) on memory recall accuracy and susceptibility to PEI. When the re-enactment was not present, there were 27, 27 and 28 participants in the no crime, ambiguous crime and unambiguous crime conditions, respectively. When the re-enactment was present, there were 26, 27 and 27 participants in the no crime, ambiguous crime and unambiguous crime conditions, respectively.

Materials

Eyewitness stimulus. The eyewitness stimulus was identical to the video(s) that participants viewed in Experiment 1, with the exception that the distractor task was removed. That is, participants were not required to report the seconds and number of buses that passed in each segment of the video; instead, they were told that they would be asked questions about their time perception ability after the video. The breaks between the video segments were therefore removed, and instead the eyewitness stimulus was played continuously throughout. The lengths of each video and the details within each video remained unchanged.

Crime awareness. As in Experiment 1, participants were asked at the conclusion of the entire study whether they believed they had seen a crime in the original video. However, in Experiment 2 participants were also asked a question assessing their awareness of a crime immediately after viewing the eyewitness

stimulus. Immediately following the video, participants were asked whether they saw anything unusual in the video and, if so, to briefly provide detail about what they saw. This question was chosen to allow participants the opportunity to report the crime and to understand the participants' interpretation of the event, while not probing for specific information that might affect their memory or awareness in the second session.

Recall coding. The same coding system as that from Experiment 1 was adopted in Experiment 2. A random 25% of all participant responses ($n = 41$) were coded by two independent scorers to assess for inter-rater reliability. Significant correlations were found between the independent coders for correct ($r = .952$, $n = 41$, $p < .01$, two-tailed), incorrect ($r = .877$, $n = 41$, $p < .01$, two-tailed), correct PEI ($r = .913$, $n = 41$, $p < .01$, two-tailed) and misinformation ($r = .741$, $n = 41$, $p < .01$, two-tailed).

Procedure

Like Experiment 1, participants completed personality questionnaires prior to viewing the eyewitness stimulus. Participants were instructed to imagine that they were present at the bus stop and waiting for a particular bus to arrive. Unlike Experiment 1 (where a distractor task was issued throughout the video), participants were instead told to pay attention to the video, as they would be asked questions regarding their time perception afterwards. In Experiment 2, participants were not asked to complete the State-STAI (Spielberger, 1983). Instead, participants were asked whether they noticed anything unusual in the video and, if so, to briefly describe what they saw in order to assess for their awareness of crime in Session 1. The procedure for Session 2 (viewing the re-enactment and completing the recall tasks) was identical to that in Experiment 1. All aspects of the study were approved by the University's Human Research Ethics Committee.

Results

Preliminary analyses

Initial analyses were conducted to ensure that gender and age were matched across between-subjects conditions. Chi-square analyses revealed no significant differences in gender across crime ambiguity, $\chi^2(2, N = 162) = 1.287$, $p = .525$, or re-enactment conditions, $\chi^2(1, N = 162) = 0.634$, $p = .426$. One-way ANOVAs revealed no significant difference between crime ambiguity, $F(2, 159) = 0.661$, $p = .518$, and re-enactment conditions, $F(1, 160) = 0.834$, $p = .363$, in regard to participant age.

No participants correctly identified the aims of the study in either session. Five participants reported that they had discussed the original video with another person in between first and second sessions; however, excluding these participants had no effect on the analyses, so all participants were kept in the final analyses.

Crime awareness

Awareness of a crime taking place in the eyewitness stimulus was measured at two time points: immediately after the eyewitness stimulus in Session 1, and after all questionnaires were completed in Session 2. In Session 1, awareness was measured by asking participants whether they noticed anything unusual while viewing the video. Two independent coders classified participants' responses as being either aware or unaware of the crime. Coders were consistent in their categorization for all participants; therefore, subsequent awareness analyses were conducted using the Session 1 data only.

Differences in crime awareness immediately after the eyewitness event were compared across crime ambiguity conditions using a chi-square test. The chi-square revealed a significant difference in crime awareness based on the ambiguity of the crime, $\chi^2(2, N = 162) = 77.163$, $p < .001$. Follow-up analyses showed that there were no differences in crime awareness during Session 1 between

Table 3. Self-reported awareness of crime across crime conditions and sessions.

| | Crime conditions | | | | | |
| | No crime | | Ambiguous crime | | Unambiguous crime | |
Session	Yes N (%)	No N (%)	Yes N (%)	No N (%)	Yes N (%)	No N (%)
Session 1	1 (1.9)	52 (98.1)	39 (72.2)	15 (27.8)	43 (78.2)	12 (21.8)
Session 2	3 (5.7)	50 (94.3)	40 (74.1)	14 (25.9)	48 (87.3)	7 (12.7)

Note: $N = 162$. Percentages across condition.

those who saw the unambiguous crime and those who saw the ambiguous crime, $\chi^2(1, N = 109) = 0.519$, $p = .471$. However, those who saw the ambiguous crime were more likely to report being aware of the crime than those who saw the no-crime video, $\chi^2(1, N = 107) = 56.528$, $p < .001$, and those who saw the unambiguous crime were more likely to report being aware of the crime than those who saw the no-crime video, $\chi^2(1, N = 108) = 65.076$, $p < .001$. The same patterns of results emerged when comparing crime awareness reported in Session 2 across crime condition groups. The number of participants who reported being aware of the crime or not in both Session 1 and Session 2, across the different crime ambiguity conditions, is shown in Table 3.

Guided free recall

Correct details. A two-way ANOVA revealed a significant main effect of crime ambiguity on number of correct details reported, $F(2, 156) = 3.541$, $p = .031$, $\eta^2_p = .043$. Post hoc contrasts showed that while participants who saw the ambiguous crime ($M = 42.04$, $SD = 14.00$) provided more correct detail than participants who saw the unambiguous crime ($M = 36.16$, $SD = 12.26$) or the video containing no crime ($M = 36.56$, $SD = 12.10$), none of these differences remained significant after Bonferroni corrections [*no crime vs. ambiguous crime: F*(1, 156) = 4.871, $p = .029$, $\eta^2_p = .030$; *ambiguous crime vs. unambiguous crime: F*(1, 156) = 5.716, $p = .018$, $\eta^2_p = .035$; *no crime*

vs. unambiguous crime: F(1, 156) = 0.026, $p = .871$, $\eta^2_p < .001$].[6] The main effect for re-enactment presence, $F(1, 156) = 1.534$, $p = .217$, $\eta^2_p = .010$, and the interaction between re-enactment presence and crime ambiguity on number of correct details reported, $F(2, 156) = 0.340$, $p = .712$, $\eta^2_p = .004$, were not significant.

Incorrect details. The number of incorrect details reported based on re-enactment presence and crime ambiguity was explored using a two-way ANOVA. The ANOVA revealed no significant main effects of crime ambiguity, $F(2, 156) = 1.227$, $p = .296$, $\eta^2_p = .015$[7] or re-enactment, $F(1, 156) = 0.470$, $p = .494$, $\eta^2_p = .003$, on number of incorrect details reported. Likewise, there was no significant interaction between re-enactment presence and crime ambiguity on number of incorrect details reported, $F(2, 156) = 0.097$, $p = .907$, $\eta^2_p < .001$.

Correct post-event information. The effect of re-enactment presence and crime ambiguity on the number of correct PEI items correctly accepted by participants was analysed with a two-way ANOVA. The main effects of crime ambiguity,[8] $F(2, 156) = 2.887$, $p = .059$, $\eta^2_p = .036$, and re-enactment, $F(1, 156) = 0.643$, $p = .424$, $\eta^2_p = .004$, were both not significant. Additionally, the interaction between re-enactment and crime ambiguity on reporting of correct PEI items was also not significant, $F(2, 156) = 0.385$, $p = .681$, $\eta^2_p = .005$.

Misinformation. A two-way ANOVA was conducted on the number of misinformation items reported based on re-enactment and crime ambiguity conditions. There was a significant effect of re-enactment presence on number of misinformation items reported, $F(1, 156) = 11.952$, $p = .001$, $\eta^2_p = .071$. Specifically, participants who viewed the re-enactment ($M = 1.45$, $SD = 1.40$) reported significantly more misinformation than participants who did not view the re-enactment ($M = 0.82$, $SD = 0.89$). The interaction, $F(2, 125) = 0.576$, $p = .563$, $\eta^2_p = .007$, and main effect of crime ambiguity,[9] $F(2, 125) = 2.462$, $p = .089$, $\eta^2_p = .031$, were both not significant.

Within-groups analyses were further conducted to determine how viewing the re-enactment within each crime condition impacted upon misinformation acceptance. Within the no crime condition, there was a significant effect of crime re-enactment on number of misinformation items reported, $F(1, 51) = 4.408$, $p = .041$, $\eta^2_p = .080$. Participants who viewed the re-enactment ($M = 1.62$, $SD = 1.79$) reported significantly more misinformation than participants who did not view the re-enactment ($M = 0.82$, $SD = 0.83$). Likewise, within the ambiguous crime condition, there was a significant effect of crime re-enactment on number of misinformation items reported, $F(1, 52) = 5.456$, $p = .023$, $\eta^2_p = .095$, whereby participants who viewed the re-enactment ($M = 1.70$, $SD = 1.24$) reported significantly more misinformation than those who did not ($M = 0.96$, $SD = 1.09$).[10] However, for the unambiguous crime condition, there was no effect of re-enactment on reporting of misinformation, $F(1, 53) = 2.173$, $p = .146$, $\eta^2_p = .039$.

Accuracy. A two-way ANOVA was conducted to determine whether statement accuracy (proportion of correct details by total details reported) was influenced by the presence of the re-enactment or the ambiguity of the crime. The ANOVA found no significant main effects of crime ambiguity, $F(2, 156) =$ 0.541, $p = .583$, $\eta^2_p = .007$, or re-enactment, $F(1, 156) = 1.250$, $p = .265$, $\eta^2_p = .008$, on recall accuracy. Likewise, there was no significant interaction between re-enactment presence and crime ambiguity on accuracy, $F(2, 156) = 0.470$, $p = .626$, $\eta^2_p = .006$.

Influence of re-enactment

Participants who viewed the re-enactment before providing their recall were asked at the end of the study the extent to which they believed the re-enactment had influenced their memory. The pattern of responses to this question is presented in Table 4. A chi-square revealed no differences across ambiguity conditions in how influential the re-enactment was perceived to be, $\chi^2(8, N = 80) = 7.587$, $p = .475$.

Discussion

The current experiments explored the effects of crime re-enactment videos, commonly used within Crime Stoppers programmes, on eyewitness memory. Despite the fact that crime re-enactment videos are considered useful by law enforcement (AIC, 2003), no studies had ever empirically studied their usefulness in the context of their effect on eyewitness memory. Across both experiments, the findings suggested that while the majority of participants who viewed the re-enactment believed it had at least some effect on their memory, this effect turned out to be predominantly negative.

Table 4.   The extent to which participants in the re-enactment condition believed the re-enactment affected their memory.

Extent of belief	Participants N (%)
Not at all	14 (17.5)
Slightly	20 (25.0)
Somewhat	26 (32.5)
Very	19 (23.8)
Extremely	1 (1.3)

Note: $N = 80$.

While crime re-enactments did not have a negative impact on the overall accuracy or completeness of participants' free recall accounts, the misinformation within the crime re-enactment appeared to distort witnesses' memory for those details. Such a finding brings in question the utility of crime re-enactments for criminal investigations.

It was expected that exposure to a crime re-enactment would posit some benefit to participants' memory, as the re-enactment contained a number of details that were consistent with the original event. Given that previous research has shown that witnesses who are exposed to correct PEI are significantly more accurate on these items than participants not exposed to the PEI (Harkness et al., 2015; Paterson & Kemp, 2006), it was expected that the same would occur in the current studies. That is, it was hypothesized that participants who saw the re-enactment would report more of the correct PEI items than participants who did not see the re-enactment. This hypothesis was largely unsupported. In other words, there was no evidence for the hypothesis in the guided free recall (Experiments 1 and 2); however, in the cued recall more correct PEI was reported by participants who viewed the re-enactment in Experiment 1 only. Reporting of correct PEI was generally quite low in the current studies compared to previous studies looking at correct PEI (e.g. 50%: Harkness et al., 2015), with approximately only 11 and 20% of correct PEI being reported across Experiments 1 and 2, respectively. One reason for the low acceptance of correct PEI could be that the correct PEI was predominantly in regard to peripheral details, such as setting details (see Appendix for full list of correct PEI). Given that crime re-enactments do re-expose witnesses to the setting where the crime originally occurred (AIC, 2003), it is reasonable to expect a similar breakdown of correct PEI to be reflected in real re-enactments used by Crime Stoppers programmes. As such,

participants who viewed the re-enactment may not have reported more correct PEI because this information had already been captured within the re-enactment. Practically, participants may have felt that they needed to provide information regarding the undiscovered details, as it is this information that would be pivotal to furthering a criminal investigation. Therefore, exposure to correct PEI within the re-enactment generally did not benefit viewers of the re-enactment, and viewing a re-enactment did not lead participants to report more of the correct details within it.

It was also expected that viewing the re-enactment would lead viewers to provide a more accurate statement during guided free recall, as the re-enactment may have acted as a form of physical context reinstatement that has previously been shown to be beneficial to witnesses (Hershkowitz et al., 2002; Smith & Vela, 1992). However, again this finding was not supported by the current studies. Previous studies have demonstrated that physical context reinstatement effects are generally weaker than mental context reinstatement effects (Davies & Milne, 1985; Hershkowitz et al., 2002). This may suggest that simply revisiting the scene of the crime without engaging in mental context reinstatement techniques may not improve overall memory. In addition, as the crime re-enactment consisted of reinstatement of context through viewing a video, it is possible that this is not equivalent to being physically present at the original scene, which may also explain why it did not facilitate memory retrieval as anticipated. Given this, crime re-enactments may be more beneficial to witnesses if they can better allow witnesses to reflect back on the events that took place using mental context reinstatement techniques, as opposed to merely re-exposing witnesses to the scene. Future research should explore how best to achieve context reinstatement within crime re-enactment videos, in order to improve the memory of witnesses and the utility of crime re-enactments.

While there do not appear to be many positive effects of crime re-enactments on memory, the findings indicate that they can have a *negative* influence on memory. Specifically, participants who viewed the re-enactment reported significantly more misinformation that had been provided throughout the re-enactment. This finding is unsurprising given that research over several decades has documented the dangers of exposing witnesses to misinformation about an event after it has occurred (see Loftus, 2005, for a review), even when warnings regarding misinformation are provided (e.g. Monds et al., 2013; Paterson et al., 2011). Therefore, the warnings provided in the re-enactment were not sufficient in enabling participants to correctly attribute the source of the misinformation purely to the re-enactment (as per the Source Monitoring Framework: Johnson et al., 1993). This is concerning given that misinformation may feature in crime re-enactments, given how they are designed (i.e. with incomplete information about a crime) and with their purpose of gathering more information about a crime from witnesses. In the current study, most misinformation was in relation to person descriptors due to the use of actors: information that would be vital for witnesses to report accurately (Rosenbaum et al., 1989). Worryingly, re-enactments broadcast onto television may be highly sensationalized for the purposes of increasing viewership (AIC, 2003; Lurigio & Rosenbaum, 1991), which may exacerbate the negative effects on eyewitness memory, as they are more compelling. With these things in mind, the use of actors within crime re-enactments may be at odds with the purposes of the re-enactment in getting witnesses to provide useful and accurate information about offenders to authorities (AIC, 2003; Rosenbaum et al., 1989), and providing warnings regarding the use of actors appears to be an ineffective safeguard in protecting witnesses from memory distortion caused by misinformation exposure. Thus, re-enactments should avoid portraying inaccurate information, and ensure that actors are as similar to the existing witness descriptions as possible, in order to minimize the amount of misinformation that they contain.

It was further expected that the influence of crime re-enactments on eyewitness memory, albeit positive or negative, would differ based on the nature of the crime that occurred and therefore the witness's awareness that a crime had taken place. For certain crimes, witnesses are not necessarily aware that a crime has occurred (James, 1986; Lane, 2006), and their accuracy can often depend on how serious they perceive the crime to be as it is unfolding (Leippe et al. 1978). It was therefore expected that the ambiguity of the crime would impact upon participants' awareness of the crime, and that participants who viewed no crime or an ambiguous crime would rely more on the contents of the re-enactment to assist them with providing relevant information about the event. However, in no case was the influence of the re-enactment impacted upon by the ambiguity of the crime. Instead, awareness of whether the event had constituted a crime did not differ between participants who saw the unambiguous or ambiguous kidnapping, and this was found when a distractor task was present (Experiment 1) and absent (Experiment 2).

The current study did find that there were differences in memory based on the ambiguity of the crime (particularly during cued recall). These differences appeared to be mostly consistent with the notion that the criminal events (the unambiguous and ambiguous kidnapping) were remembered differently to the neutral event (the no crime condition). In cued recall during Experiment 1, participants who viewed the unambiguous kidnapping were more complete and accurate than participants who viewed the no crime video. In cued recall during Experiment 2, this same pattern was present for the ambiguous kidnapping, as participants who saw this event were more complete than participants who saw the no crime video. Such findings during cued recall

do suggest that awareness may play a role in the quality of a witness's memory in the face of specific questioning regarding a crime. However, when looking within each crime condition, it was found that even participants within the ambiguous and unambiguous crime conditions were susceptible to accepting misinformation they had viewed in the re-enactment. These findings therefore suggest that poorer memory strength (i.e. through viewing a neutral, no crime event) may not lead participants to be more likely to accept misinformation, as has been previously suggested (Lindsay, 1993; Pezdek & Roe, 1995), as participants in the ambiguous and unambiguous conditions were at times more accurate and complete, but still susceptible to reporting misinformation.

The complex findings in regard to crime ambiguity suggest that the ambiguity of a crime may have a vital role to play in what (and how accurately) eyewitnesses will remember. Despite this, crime ambiguity has been an area of research that has been largely neglected, as most of the research on eyewitness memory forewarns participants that they will witness a crime, when naturally this might not be the case (Rivardo et al., 2011). Promisingly, the lack of difference across both studies regarding awareness of the crime suggests that even ambiguous crimes may be deemed as suspicious and serious by bystanders, which based on Leippe and colleagues (1978), may in turn mean that witnesses who view ambiguous crimes can still provide accurate information about them. Future research should further explore the effect of crime ambiguity separately to crime re-enactments, as the two do not seem to influence one another in relation to eyewitness memory. This would allow for a better understanding of how the ambiguity of the crime and witness awareness of crime occurring influence the accuracy of their memory.

Limitations of the present experiments should be noted when generalizing the findings to real-life eyewitness settings. Firstly, both experiments recruited undergraduate psychology students as mock witnesses, which may reduce the generalizability of the findings to other distinct populations (such as elderly eyewitnesses: Yarmey & Kent, 1980). In addition, real unexpected crimes are likely to be more arousing than the eyewitness stimuli used within the current study, and an eyewitness's stress may play a role in how well they remember a criminal event (Deffenbacher et al., 2004). Given that Experiment 1 revealed no significant differences in changes in state anxiety across participants allocated to view different versions of the eyewitness event, this could be attributed to the low emotional valence of these videos. Future research would benefit from considering the impact of crime ambiguity with crimes eliciting a greater emotional response from participants, should they be interpreted as crimes.

Taken together, the findings from both experiments suggest that despite the fact that crime re-enactments are popular tools for gathering information about unsolved crimes (AIC, 2003; Rosenbaum et al., 1989), the accuracy of the information that eyewitnesses provide after viewing a crime re-enactment on television should be treated with caution. Crime re-enactments are vital tools that are essential for encouraging witnesses to come forward with information about crimes that they have witnessed (Gresham et al., 2003) and may not have initially been aware of. However, the findings of the two experiments suggest that witnesses' memories may be distorted through the misinformation provided within a crime re-enactment, and that a re-enactment may not improve eyewitness memory in any way. It is important that future research be devoted to devising new safeguards to protect witnesses from misinformation contained within a re-enactment, and to protect witnesses against inaccuracies caused through dramatization of the re-enactment. It is also important that future research considers the motivations that lead witnesses to provide information after seeing a re-enactment. For example, re-enactments

often contain a promise of a cash reward as an incentive for witnesses to report to Crime Stoppers (Rosenbaum et al., 1989). In addition, many witnesses report after viewing a crime re-enactment under the promise of anonymity (Gresham et al., 2003). Such factors may further impact upon the utility of crime re-enactments, and future research should explore how such factors further influence an eyewitness's memory upon viewing a crime re-enactment.

Ethical standards

Declaration of conflicts of interest

Hayley Cullen has declared no conflicts of interest

Helen Paterson has declared no conflicts of interest

Celine van Golde has declared no conflicts of interest

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the University of Sydney Human Research Ethics Committee [protocol number 2015/315] and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the study

Notes

1. For completeness of cued recall, while it was again found that participants who saw the ambiguous crime provided significantly more detail than participants who saw the no crime video, additionally participants who saw the unambiguous crime provided significantly more correct detail ($M = 16.46$, $SD = 6.85$) than participants who saw the no crime video ($M = 9.17$, $SD = 6.26$), $F(1, 128) = 18.124$, $p < .001$, $\eta^2_p = .124$.

2. There was a significant main effect of crime ambiguity, $F(2, 128) = 3.889$, $p = .023$, $\eta^2_p = .057$. Post hoc contrasts revealed that participants who viewed the unambiguous crime reported significantly more correct PEI during cued recall ($M = 8.96$, $SD = 4.34$) than participants who viewed the no crime video ($M = 6.30$, $SD = 4.61$), $F(1, 128) = 6.992$, $p = .009$, $\eta^2_p = .052$. There was also a significant main effect of crime re-enactment, $F(1, 128) = 7.849$, $p = .006$, $\eta^2_p = .058$. Participants who viewed the re-enactment reported significantly more correct PEI items ($M = 9.03$, $SD = 5.02$) than participants not shown the re-enactment ($M = 6.76$, $SD = 4.49$).

3. For cued recall, there was a significant effect of crime ambiguity on number of misinformation items reported, $F(2, 128) = 4.007$, $p = .021$, $\eta^2_p = .059$. The only post hoc contrast that was significant was that those who observed the unambiguous crime ($M = 1.00$, $SD = 1.24$) reported significantly more misinformation than those who observed no crime ($M = 0.44$, $SD = 0.80$), $F(1, 128) = 7.869$, $p = .006$, $\eta^2_p = .058$.

4. For cued recall, participants within the ambiguous crime condition reported significantly more misinformation when they viewed the re-enactment ($M = 1.09$, $SD = 0.90$) than when they did not ($M = 0.48$, $SD = 0.73$), $F(1, 44) = 6.341$, $p = .016$, $\eta^2_p = .126$. Likewise, participants within the unambiguous crime condition reported significantly more misinformation during cued recall when they viewed the re-enactment ($M = 1.48$, $SD = 1.41$) than when they did not ($M = 0.50$, $SD = 0.80$), $F(1, 43) = 8.084$, $p = .007$, $\eta^2_p = .158$.

5. A significant main effect of crime ambiguity was found for statement accuracy in cued recall, $F(2, 128) = 4.886$, $p = .009$, $\eta^2_p = .071$. Post hoc contrasts showed that the only contrast that lasted through Bonferroni corrections was that participants who saw the unambiguous crime were significantly more accurate in cued recall ($M = 73.76$, $SD = 14.80$) than participants who saw the no crime video ($M = 58.84$, $SD = 29.76$), $F(1, 128) = 8.938$, $p = .003$, $\eta^2_p = .065$.

6. For completeness of cued recall, post hoc contrasts revealed that participants who saw the ambiguous crime ($M = 18.93$, $SD = 7.77$) provided significantly more correct detail than participants who saw the

no crime video ($M = 11.82$, $SD = 6.26$), $F(1, 156) = 29.446$, $p < .001$, $\eta^2_p = .159$, and participants who saw the unambiguous crime ($M = 15.25$, $SD = 5.99$), $F(1, 156) = 8.024$, $p = .005$, $\eta^2_p = .049$. Participants who saw the unambiguous crime also provided significantly more correct detail than participants who saw the no crime video, $F(1, 156) = 6.925$, $p = .009$, $\eta^2_p = .043$.

7. During cued recall, there was a significant main effect of crime ambiguity on the number of incorrect details reported, $F(2, 156) = 5.965$, $p = .003$, $\eta^2_p = .071$. Post hoc contrasts revealed that participants who viewed the ambiguous crime ($M = 5.82$, $SD = 2.98$) reported significantly more incorrect details than participants who viewed the no crime video ($M = 4.03$, $SD = 2.96$), $F(1, 156) = 11.139$, $p = .001$, $\eta^2_p = .067$, and those who viewed the unambiguous crime ($M = 4.53$, $SD = 2.23$), $F(1, 156) = 5.948$, $p = .016$, $\eta^2_p = .037$.

8. For number of correct PEI items reported during cued recall, there was a significant main effect of crime ambiguity, $F(2, 156) = 4.860$, $p = .009$, $\eta^2_p = .059$. Post hoc contrasts revealed that participants who viewed the ambiguous crime reported significantly more correct PEI ($M = 9.54$, $SD = 3.31$) than participants who saw the no crime video ($M = 7.64$, $SD = 3.40$), $F(1, 156) = 9.024$, $p = .003$, $\eta^2_p = .055$. No other contrasts were significant.

9. In cued recall, there was also a significant difference in the number of misinformation items reported based on crime ambiguity, $F(2, 156) = 8.097$, $p < .001$, $\eta^2_p = .094$. Post hoc contrasts revealed that participants in the ambiguous crime condition reported significantly more misinformation ($M = 1.81$, $SD = 1.29$) than participants in the no crime condition ($M = 1.04$, $SD = 1.00$), $F(1, 156) = 13.655$, $p < .001$, $\eta^2_p = .080$, and than participants in the unambiguous crime condition ($M = 1.15$, $SD = 0.95$), $F(1, 156) = 10.414$, $p = .002$, $\eta^2_p = .063$. However, there was no difference between the no crime condition and unambiguous crime condition in number of misinformation items reported during cued recall, $F(1, 156) = 0.250$, $p = .618$, $\eta^2_p = .002$.

10. In cued recall, there was no difference within each crime condition in regard to misinformation reported.

ORCID

Hayley J. Cullen http://orcid.org/0000-0002-0406-4912
Helen M. Paterson http://orcid.org/0000-0002-9283-4349
Celine van Golde http://orcid.org/0000-0002-1950-4722

References

Australian Institute of Criminology. (2003). *Crime stoppers: Evaluating Victoria's Program* (Report No. 272). Retrieved from https://aic.gov.au/publications/tandi/tandi272

Chabris, C.F., Weinberger, A., Fontaine, M., & Simons, D.J. (2011). You do not talk about Fight Club if you do not notice Fight Club: Inattentional blindness for a simulated real-world assault. *i-Perception*, 2(2), 150–153. doi:10.1068/i0436

Crime Stoppers Australia (2018). *Corporate plan.* Retrieved from https://www.crimestoppers.com.au/sites/default/files/2018-05/CSA1002.pdf

Crime Stoppers Queensland (2014). *History.* Retrieved from https://www.crimestoppersqld.com.au/discover/history.jsp#.XDMdI88zZE4

Davies, G., & Milne, A. (1985). Eyewitness composite production: A function of mental or physical reinstatement of context. *Criminal Justice and Behavior*, 12(2), 209–220. doi:10.1177/0093854885012002004

Deffenbacher, K.A., Bornstein, B.H., Penrod, S.D., & McGorty, E.K. (2004). A meta-analytic review of the effects of high stress on eyewitness memory. *Law and Human Behavior*, 28(6), 687–706. doi:10.1007/s10979-004-0565-x

Echterhoff, G., Hirst, W., & Hussy, W. (2005). How eyewitnesses resist misinformation: Social postwarnings and the monitoring of memory characteristics. *Memory & Cognition*, 33(5), 770–782. doi:10.3758/BF03193073

Frenda, S.J., Nichols, R.M., & Loftus, E.F. (2011). Current issues and advances in misinformation research. *Current Directions in*

Psychological Science, *20*(1), 20–23. doi:10.1177/0963721410396620

Gresham, P.J., Stockdale, J., & Bartholomew, I. (2003). *Evaluating the impact of Crimestoppers* (Home Office Report 22/03). London.

Greene, E., Flynn, M.S., & Loftus, E.F. (1982). Inducing resistance to misleading information. *Journal of Verbal Learning and Verbal Behavior*, *21*(2), 207–219. doi:10.1016/S0022-5371(82)90571-0

Harkness, E.L., Paterson, H.M., Denson, T., Kemp, R.I., Mullan, B., & Sainsbury, K. (2015). Can ego depletion and post-event discussion change the way we remember a crime? *Psychiatry, Psychology and Law*, *22*(2), 172–183. doi:10.1080/13218719.2014.924384

Hershkowitz, I., Orbach, Y., Lamb, M.E., Sternberg, K.J., & Horowitz, D. (2002). A comparison of mental and physical context reinstatement in forensic interviews with alleged victims of sexual abuse. *Applied Cognitive Psychology*, *16*(4), 429–441. doi:10.1002/acp.804

Innocence Project, New York, United States. (2015). *The causes of wrongful conviction.* Retrieved from http://innocenceproject.org/causes-wrongful-conviction

James, K. (1986). Priming and social categorization factors: Impact on awareness of emergency situations. *Personality and Social Psychology Bulletin*, *12*(4), 462–467. doi:10.1177/0146167286124009

Johnson, M.K., Hashtroudi, S., & Lindsay, D.S. (1993). Source monitoring. *Psychological Bulletin*, *114*(1), 3–28. doi:10.1037/0033-2909.114.1.3

Kebbell, M.R., & Milne, R. (1998). Police officers' perceptions of eyewitness performance in forensic investigations. *The Journal of Social Psychology*, *138*(3), 323–330. doi:10.1080/00224549809600384

Krafka, C., & Penrod, S. (1985). Reinstatement of context in a field experiment on eyewitness identification. *Journal of Personality and Social Psychology*, *49*(1), 58–69. doi:10.1037/0022-3514.49.1.58

Lane, S.M. (2006). Dividing attention during a witnessed event increases eyewitness suggestibility. *Applied Cognitive Psychology*, *20*(2), 199–212. doi:10.1002/acp.1177

Leippe, M.R., Wells, G.L., & Ostrom, T.M. (1978). Crime seriousness as a determinant of accuracy in eyewitness identification. *Journal of Applied Psychology*, *63*(3), 345–351. doi:10.1037/0021-9010.63.3.345

Lindsay, D.S. (1993). Eyewitness suggestibility. *Current Directions in Psychological Science*, *2*(3), 86–89. doi:10.1111/1467-8721.ep10770942

Loftus, E.F. (2005). Planting misinformation in the human mind: A 30-year investigation of the malleability of memory. *Learning & Memory*, *12*(4), 361–366. doi:10.1101/lm.94705

Lurigio, A.J., & Rosenbaum, D.P. (1991). The effects of mass media on crime prevention awareness, attitudes, and behaviour: The case of crime stoppers. *American Journal of Criminal Justice*, *15*(2), 82–105. doi:10.1007/BF02885621

Migueles, M., & García-Bajos, E. (1999). Recall, recognition, and confidence patterns in eyewitness testimony. *Applied Cognitive Psychology*, *13*(3), 257–268. doi:10.1002/(SICI)1099-0720(199906)13:3<257::AID-ACP566>3.0.CO;2-7

Monds, L.A., Paterson, H.M., & Whittle, K. (2013). Can warnings decrease the misinformation effect in post-event debriefing?. *International Journal of Emergency Services*, *2*(1), 49–59. doi:10.1108/IJES-06-2012-0025

Morgan, C.A., Southwick, S., Steffian, G., Hazlett, G.A., & Loftus, E.F. (2013). Misinformation can influence memory for recently experienced, highly stressful events. *International Journal of Law and Psychiatry*, *36*(1), 11–17. doi:10.1016/j.ijlp.2012.11.002

Nelson, K.J., Laney, C., Bowman Fowler, N., Knowles, E.D., Davis, D., & Loftus, E.F. (2011). Change blindness can cause mistaken eyewitness identification. *Legal and Criminological Psychology*, *16*(1), 62–74. doi:10.1348/135532509X482625

Paterson, H.M., & Kemp, R.I. (2006). Comparing methods of encountering post-event information: The power of co-witness suggestion. *Applied Cognitive Psychology*, *20*(8), 1083–1099. doi:10.1002/acp.1261

Paterson, H.M., Kemp, R.I., & Ng, J. (2011). Combating co-witness contamination: Attempting to decrease the negative effects of discussion on eyewitness memory. *Applied Cognitive Psychology*, *25*(1), 43–52. doi:10.1002/acp.1640

Pezdek, K., & Roe, C. (1995). The effect of memory trace strength on suggestibility. *Journal of Experimental Child Psychology*, *60*(1), 116–128. doi:10.1006/jecp.1995.1034

Pfuhl, E.H. Jr. (1992). Crimestoppers: The legitimisation of snitching. *Justice Quarterly*, *9*(3), 505–528. doi:10.1080/07418829200091501

Rivardo, M.G., Brown, K.A., Rodgers, A.D., Maurer, S.V., Camaione, T.C., Minjock, R.M., & Gowen, G.M. (2011). Integrating inattentional blindness and eyewitness memory. *North American Journal of Psychology*, *13*, 519–538.

Rosenbaum, D.P., Lurigio, A.J., & Lavrakas, P.J. (1989). Enhancing citizen participation and solving serious crime: A national evaluation of Crime Stoppers programs. *Crime & Delinquency*, *35*, 401–420.

Sharps, M.J., Herrera, M.R., & Price-Sharps, J.L. (2014). Situationally equivocal eyewitness evidence and the violence of crimes. *Journal of Investigative Psychology and Offender Profiling*, *11*(1), 81–93. doi:10.1002/jip.1398

Simons, D.J., & Chabris, C.F. (1999). Gorillas in our midst: Sustained Inattentional blindness for dynamic events. *Perception*, *28*(9), 1059–1074. doi:10.1068/p2952

Smith, S.M., & Vela, E. (1992). Environmental context-dependent eyewitness recognition. *Applied Cognitive Psychology*, *6*(2), 125–139. doi:10.1002/acp.2350060204

Spielberger, C.D. (1983). *Manual for the State-Trait Anxiety Inventory STAI (Form Y)*. Palo Alto, CA: Consulting Psychologists Press.

Vredeveldt, A., Hildebrandt, A., & Van Koppen, P.J. (2016). Acknowledge, repeat, rephrase, elaborate: Witnesses can help each other remember more. *Memory (Hove, England)*, *24*(5), 669–682. doi:10.1080/09658211.2015.1042884

Wright, D.B., Self, G., & Justice, C. (2000). Memory conformity: Exploring misinformation effects when presented by another person. *British Journal of Psychology*, *91*(2), 189–202. doi:10.1348/000712600161781

Wright, D.B., & Stroud, J.N. (1998). Memory quality and misinformation for peripheral and central objects. *Legal and Criminological Psychology*, *3*(2), 273–286. doi:10.1111/j.2044-8333.1998.tb00366.x

Yarmey, A.D., & Kent, J. (1980). Eyewitness identification by elderly and young adults. *Law and Human Behavior*, *4*(4), 359–371. doi:10.1007/BF01040627

Appendix

Post-event information (PEI)

Full list of misinformation items (total = 21)

Detail	Category	Original video	Misinformation
What the child does after being dropped off at the bus stop	Action	Walks over to the bus timetable	Heads directly to the bench
When the perpetrator arrives	Action	Arrives after the child	Arrives before the child
What the perpetrator is doing when they arrive	Action	Approaches the child	Watches the child
How the perpetrator looks at the child	Action	Is not staring at child upon arrival	Is staring at child upon arrival
The colour of the car the child is dropped off in	Object	Red	Blue
The colour of the backpack the child carries	Object	Black	Purple and blue
The way the child wears their hair	Person	In a ponytail/tied back	Worn loose
The type of hair the child had	Person	Straight hair	Curly hair
The colour of the child's shirt	Person	Black and white	Yellow
The type of bottoms the child was wearing	Person	Tights	Shorts/skirt
The colour of the child's bottoms	Person	Black	Blue
What the child was wearing on their head	Person	Nothing	A headband
The colour of the thing the child was wearing on their head	Person	Nothing	Silver
What the child looked like when they got out of the car	Person	Neutral	Happy/smiling
The age of the perpetrator	Person	Middle aged	Early 30s
The colour of the perpetrator's hair	Person	Brown/dark blonde	Light blonde
The way the perpetrator's hair was worn	Person	Ponytail/tied back	Worn loose
The top the perpetrator was wearing	Person	A cardigan	A jacket
The colour of the perpetrator's top	Person	Grey	Black
The bottoms the perpetrator was wearing	Person	Skirt/dress	Pants
What the perpetrator was wearing around their neck	Person	Nothing	A scarf

Full list of correct PEI (total = 68)

Category	Detail
Action	
	Car pulls up on the side of the road
	Car drops somebody off
	Child gets out of the car
	Child gets out of car passenger seat
	Child shuts the door
	Child waves to the driver
	Child makes way to the bench
Object	
	A car arrives at the bus stop
	The child has a backpack
	The child was carrying an object
	The object the child was carrying was a ball
	The ball the child was carrying was round
Person	
	A child arrives at the bus stop
	The child is a girl
	The child is alone
	The child is 8 years old
	The child is approximately 4 feet tall
	The child is slim
	The child is Caucasian
	The child has dark blonde/light brown hair
	The child has medium to long length hair
	The child is wearing glasses
	The child's glasses are purple
	The child is wearing a t-shirt
	The child's t-shirt is short sleeved
	A lady enters the scene
	The lady is alone
	The lady is Caucasian
	The lady is of above average build
	The lady has long hair
	The lady has straight hair
	The lady's bottoms are black
Setting	
	It was daytime
	The bus stop was in shadow
	It was sunny
	The wind was blowing
	The bus stop was unsheltered
	There was a bus stop sign
	The bus stop post was silver
	The bus stop sign was yellow
	There was a bench
	The bench was beside the bus stop sign/the sign was beside the bench

(*Continued*)

(*Continued*).

Category	Detail
	The bench was facing away from the road
	The bench was long i.e. could fit many people
	The bench was on concrete
	The bench was connected to the footpath
	The bench was black
	The bench was wooden
	The bench was painted
	There was a pathway
	The pathway was concrete
	The pathway was parallel to the road and/or bench
	The pathway separated the bench and the fence
	The pathway was in front of the bench
	The pathway was uncracked
	There was a fence
	The fence was next to the footpath
	The fence was see-through
	The fence ran parallel to the road
	The fence was opposite the bench
	There were shrubs/bushes/growth behind the fence
	There was grass between the path and road
	There was a nature strip
	The leaves were dark green on the nature strip
	The fence was made of wire/metal//chain linked
	The fence was criss-crossed
	There was a road